SELECTED TOPICS: COSC 4590
Introduction to Machine Learning
Summer 2017

A. COURSE INFORMATION

Course number/section: COSC 4590.001
Class meeting time: MW 09:30 AM-12:00 PM
Class location: IH-163
Course Website: http://sci.tamucc.edu/~asheta

B. INSTRUCTOR INFORMATION

Instructor: Dr. Alaa Sheta
Office location: CI-342
Office hours: MW 12:00-2:30 PM
Telephone: 825-3711
e-mail: alaa.sheta@tamucc.edu
Appointments: Must be scheduled at least a week in advance by email

C. COURSE DESCRIPTION

Machine Learning (ML) has been an exclusive topic in science and research. Machine learning is the branch of science concern on how to build an intelligent machine. In this course, students will learn about the state of the art on machine learning and get to know how they can use these evolving learning algorithms. ML algorithms attempt to mimic how human brain works. Our plan is to develop many exercises on how these ML algorithms work in practical applications in both industry and basic science. Some applications include modeling and control of autonomous systems, image analysis, object recognition, data mining and financial forecasting.

The theme of this course is A Guide to Intelligent Systems. We plan to cover evolutionary computation, fuzzy logic; artificial network networks, classification based decision trees, clustering, and swarm Intelligence. Students get a hand experience on a number of programming tools and a variety of applications of intelligent systems.

D. PREREQUISITES AND COREQUISITES

Prerequisites
COSC 2437 or COSC 3370

Corequisites
None
E. REQUIRED TEXTBOOK(S), READINGS AND SUPPLIES

Optional Textbook(s) or Other References


Supplies
Some way to archive your documents (Flash drive, Dropbox/Cloud, etc)

F. STUDENT LEARNING OUTCOMES AND ASSESSMENT

Assessment is a process used by instructors to help improve learning. Assessment is essential for effective learning because it provides feedback to both students and instructors. A critical step in this process is making clear the course’s student learning outcomes that describe what students are expected to learn to be successful in the course. The student learning outcomes for this course are listed below. By collecting data and sharing it with students on how well they are accomplishing these learning outcomes students can more efficiently and effectively focus their learning efforts. This information can also help instructors identify challenging areas for students and adjust their teaching approach to facilitate learning.

By the end of this course, students will:

1. Understand the basic idea of system modeling/function optimization and the meaning of training and testing dataset.
2. Understand how we can build a simple regression model with single and multiple variables.
3. Understand the meaning of search space/landscape and difficulties associated with a search for minimum or maximum of a function.
4. Understand the meaning of fitness/evaluation function that guides a search problem.
5. Learn how to formulate a real-life problem such that a Machine Learning (ML) algorithm can solve it.
6. To be able to check the strengths and weaknesses of several machine learning algorithms.
7. Understand how evolutionary computation algorithms inspired from the nature selection mechanism.
8. Learn about the advantages and weaknesses of Artificial Neural Networks (ANN).
9. Learn how ANNs behave for function approximation.
10. Learn how fuzzy logic can model nonlinear/complex function based set of linear models.
11. To be able to understand the key challenges of using ML in applications of control and data analysis.
12. Learn about the growth of ML techniques and their future impact.
G. INSTRUCTIONAL METHODS AND ACTIVITIES

This course will be a mixture of lectures and discussions. The student is expected to actively participate in all class activities. The student is also expected to do outside work on assignments, reading, class presentation and project documentation.

MAJOR COURSE REQUIREMENTS AND GRADING

This is a high-level core course. This is a theory and application course that demands all students attend all classes! Regular completion of all reading, homework, and other outside assignments, are absolutely essential for success in this course. Your course grade will be decided on your performance in the programming homework assignments, term projects, two exams and final exam. The distribution of points is as follows:

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>% of FINAL GRADE</th>
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<tbody>
<tr>
<td>Two Exams</td>
<td>30</td>
</tr>
<tr>
<td>Programming Assignments</td>
<td>30</td>
</tr>
<tr>
<td>Quizzes</td>
<td>10</td>
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<tr>
<td>Term Project</td>
<td>30</td>
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Grade Scale: A (90-100%)  B (80-89%)  C (70-79%)  D (60-69%)  F (<60%)

Homework: Assignments will significantly build on the material from the lectures. They will be posted on the course web page or hard copies are handed out in the class during the lecture or lab sessions. Please refer to the handout on programming assignments for complete details on submission requirements. (Details decided per assignment). All the assignments are due at the beginning of the class on the due date. If the student is absent on the assignment due date, it is the student's responsibility to see to it that the assignment is submitted on the designated date. Be sure to backup copies of all your programs. Note that any kind of hardware or software failure or machine unavailability in the lab does not merit an extension on the assignment. Diskettes upon which major examinations, assignments, projects or papers submitted may be retained by the instructor as a permanent record of the student's work. Each assignment should have a cover page with student name, student ID, class number, assignment name and date of submission. Failure to do that results in point's reduction. E-mail submission is not allowed. It is your responsibility to make sure that your assignment is uploaded/submitted in the proper format. No compressed files allowed. Your submission MUST be in pdf format. Please check the file type before you make your submission. Submission with incorrect format will get zero grade.
**Term Project:** The project will be a programming style project. The goal of the project is to allow students to understand, simulate and solve a real-life problem using a machine learning algorithm. A project report should be submitted at the end of the course along with an in-class presentation by each team (maximum two students). All project’s topic has to get approved by the instructor. Additional details on the project will be available later on the course website. Each team needs to give a summary of the project on/before Wednesday, June 14, 2017. A team will have to give a short (i.e. 10-15 mints) in class presentation after the approval of the project’s topic.

**Exams:** The first exam will be given on Monday 6/19/2017 and the second exam will be given on Wednesday 7/5/2017. The final exam day which is on Wednesday 7/19/2017 from 9:30–12:00 PM will be used for final project documentation delivery and project presentations.

**COURSE CONTENT/SCHEDULE**

<table>
<thead>
<tr>
<th>DATE (BY DAY OR WEEK)</th>
<th>TOPIC</th>
<th>ASSIGNMENTS</th>
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<tbody>
<tr>
<td>5/31/2017</td>
<td>Introduction to Machine Learning (ML)</td>
<td></td>
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<tr>
<td>6/5/2017</td>
<td>Linear Regression with one/many variables</td>
<td>HW1: Modeling using simple linear regression</td>
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<tr>
<td>6/7/2017</td>
<td>Tutorial on ML software</td>
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<tr>
<td>6/12/2017</td>
<td>Intro. to Evolutionary Computation (EC)</td>
<td>HW2: Parameter estimation using GAs</td>
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<tr>
<td>6/14/2017</td>
<td>Genetic Algorithms (GAs) and Genetic Programming (GP)</td>
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<tr>
<td>6/19/2017</td>
<td>Intro. to Fuzzy Logic (FL) <strong>First Exam</strong></td>
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<tr>
<td>6/21/2017</td>
<td>Implementation for FL systems</td>
<td>HW3: Implementation of a FL system</td>
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<tr>
<td>6/26/2017</td>
<td>Artificial Neural Networks: Representation</td>
<td>HW4: Implement a simple ANN Model</td>
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<tr>
<td>6/28/2017</td>
<td>Artificial Neural Networks (ANNs): Learning Algorithms</td>
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<tr>
<td>7/3/2017</td>
<td>Classification</td>
<td>HW5: Classification</td>
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<td>7/5/2017</td>
<td>Decision Tress <strong>Second Exam</strong></td>
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<tr>
<td>7/10/2017</td>
<td>Clustering</td>
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<tr>
<td>7/12/2017</td>
<td>Swarm Intelligence: Particle Swarm Optimization (PSO)</td>
<td>HW6: Parameter estimation based PSO.</td>
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<tr>
<td>7/17/2017</td>
<td>Class Presentations</td>
<td></td>
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<tr>
<td>7/19/2017</td>
<td>Class Presentations (Conti.)</td>
<td><strong>Submission of the project final report</strong></td>
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Note: Changes in this course schedule may be necessary and will be announced to the class by the Instructor. The assignments and exams shown are directly related to the Student Learning Outcomes described in Section F.

H. COURSE POLICIES

- **Course Syllabus**
  We will meet for lecture on Tuesdays and Thursdays, when new material will be presented. We will follow the text generally, but non-text material may also be included in the lectures. The assignments and exams will be given during the class hours. You are responsible for all the material presented during the lecture.

- **Attendance/Tardiness**
  You are expected to be in attendance, punctual, and prepared for class. If you are more than 5 minutes late to class, you will be counted as tardy. Please make sure that you will never be tardy to any of your classes or accept the consequences.

- **Exams**
  Exams will cover all lecture and reading material discussed in the class. Exams must be taken on the hour they are scheduled.

- **Missed Exam**
  In the event, if you cannot attend the class to take the exam due to some emergency or some unavoidable situation (such as serious illness, death in the family, participation in university sports, religious observations, and so on) you must notify me as soon as possible before the exam and also you must validate your absence by providing me a document (e.g., with a letter from your doctor). Once your cause is validated a make-up exam will be given.

- **Late Work and Make-up Exams**
  *NO makeup exams, assignments, or quizzes will be allowed unless I have agreed prior to the exam, assignment, or quiz time and been provided with official supporting documents.*

- **Grading Error**
  All questions concerning a test score or grading of a returned test or assignment must be resolved within one week. It is always a good idea to keep all of your work until the end of the semester. In case of any recording errors or doubts, you may produce them for correction or verification.

- **Extra Credit**
  There is NO EXTRA CREDIT - don't bother asking.

- **Cell Phone Use**
  You are required to turn off your cell phone in class and pay attention to class discussions.

- **Laptop Use**
  Use of laptops and other electronic devices is restricted to taking notes.

- **Food in Class**
  Eating food in class is Not Allowed.

- **Missed Exam**
  Missed exams will be graded as ‘0’.

- **Participation**
  Class discussions and information provided in class are considered regular course material; it is your responsibility to take appropriate notes. You are expected to attend lectures and actively
participate in class discussions.

- **Others**
  Read Section L!!!

I. **COLLEGE AND UNIVERSITY POLICIES**

- **Academic Integrity (University)**
  It is expected that university students will demonstrate a high level of maturity, self-direction, and ability to manage their own affairs. Students are viewed as individuals who possess the qualities of worth, dignity, and the capacity for self-direction in personal behavior. See Full University Policy at: http://catalog.tamucc.edu/content.php?catoid=10&navoid=313#Academic_Integrity

- **Classroom/Professional Behavior**
  Texas A&M University-Corpus Christi, as an academic community, requires that each individual respect the needs of others to study and learn in a peaceful atmosphere. Under Article III of the Student Code of Conduct, classroom behavior that interferes with either (a) the instructor’s ability to conduct the class or (b) the ability of other students to profit from the instructional program may be considered a breach of the peace and is subject to disciplinary sanction outlined in article VII of the Student Code of Conduct. Students engaging in unacceptable behavior may be instructed to leave the classroom. This prohibition applies to all instructional forums, including classrooms, electronic classrooms, labs, discussion groups, field trips, etc.

- **Deadline for Dropping a Course with a Grade of W (University)**
  The grade of W will be assigned to any student officially dropping a course. Please consult with the instructor before you decide to drop to be sure it is the best thing to do. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class. Should dropping the course be the best course of action, visit the Office of the University Registrar for the Course Drop Form that must be submitted. No student is eligible to receive a W without completing the official drop process by this deadline. Please consult the Academic Calendar (http://www.tamucc.edu/academics/calendar/) for the last day to drop a course.

- **Grade Appeals (College of Science and Engineering)**
  As stated in University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules website at http://www.tamucc.edu/provost/university_rules/index.html, and the College of Science and Engineering Grade Appeals webpage at http://sci.tamucc.edu/students/GradeAppeal.html. For
assistance and/or guidance in the grade appeal process, students may contact the chair or director of the appropriate department or school, the Office of the College of Science and Engineering Dean, or the Office of the Provost.

- **Disability Services**
  The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call (361) 825-5816 or visit Disability Services in Corpus Christi Hall 116.

  If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816.

  [http://disabilityservices.tamucc.edu/](http://disabilityservices.tamucc.edu/)

### J. OTHER INFORMATION

These guidelines are designed to inform scholars of their responsibilities and of the course requirements in order to make this course a positive experience. The instructor is always available for consultation and discussion with students on any aspect of a course and of these general guidelines.

1. Consider yourself as a **scholar** rather than a student. The term “student” may imply some passivity, whereas the term “scholar” implies active participation, understanding and searching. We will use these terms interchangeably with the meaning of “scholar” implied.

2. Osmosis does not work in a learning environment!

3. Further, define yourself as a “thinking explorer”. You are responsible for your education; an instructor can only be a guide and a facilitator. An instructor cannot learn for you. If you come across something that really interests you, explore it further.

4. Your experience at this University should not consist of passing a series of courses to earn a degree. Your experience should rather be a series of activities that will give you an education.

5. Concentrate on “learning to learn”. You will have to be a life-long learner to survive in your chosen career.

6. There is no such thing as a stupid question; there is such a thing as a stupid answer. So ask questions, the instructor is taking all the risks! Ask questions of your instructor and of your fellow scholars. Many times questions are more important than answers.

7. The Internet is a tremendous resource and also a great danger. When you find information on the Internet, you have no idea if it is correct. View such information with caution. But, use the Internet to explore topics that interest you. Do not only prepare for the exam in a course – learn as much as you can on the topics introduced to you by the course material. You are responsible for the extent of your education! **READ MINDFULLY !!!!**
7. In addition to details of the syllabus given in class, the syllabus for the course includes all the chapters of the required textbook/s unless indicated otherwise by the instructor.

8. The final letter grade for the class will be based on the raw composite numerical score obtained from the weighted average of the tests, quizzes, exams, labs, etc. as indicated by the instructor. The raw composite numerical score may be adjusted (curved) based on the highest score, the statistical profile of the scores and other academic standards or other considerations. Generally, the letter grade of A is 90% and over of the adjusted score, a B is between 80% and 89% (inclusive) of the adjusted score, a C is between 70% and 79% (inclusive) of the adjusted score, a D is below 70% of the adjusted score and an F is below 65% of the adjusted score. An incomplete (I) will only be given in very unusual circumstances. The University regulations on incomplete grades state: “An incomplete notation may be given to a student who is passing but has not completed a term paper, examination, or other required work for reasons beyond the student’s control other than the lack of time”. Students are expected to take ALL tests, quizzes, exams, etc., and to complete and hand in all labs and other assignments. There is no provision for “extra credit”. No final grades will be given via the telephone, e-mail, etc.

9. All University rules, regulations and expected student conduct apply to this course. Students are held responsible for the information given in the current Catalog and Student Handbook.

10. All labs, assignments, etc. must be handed in on the assigned due date. Scholars having problems must notify the instructor well before the due date. Marks will be deducted for poor and sloppily presented work.

11. Labs, etc. handed in after the due date may be subject to a penalty of loss of marks. Labs, etc. handed in after the graded labs, etc. have been returned to students will get zero marks but must be handed in to the instructor.

12. Scholars are asked to take special note of the penalties, which the University attaches to Academic Dishonesty. Consult the Student Handbook.

13. All work handed in to the instructor must be the student's own work. Extracts, excerpts, etc. from the work of others must be suitably noted, acknowledged and properly referenced. Any Group Work will be judged in the same way. That is, it is the work of the group and the extracts, excerpts, etc. of others must be acknowledged.

14. All written and graphical work handed in must be presented neatly printed. Student’s written work will be judged on written communication skills, critical thinking and problem solving ability.

15. There are NO provisions for making up missed exams except in cases where prior arrangements have been made and agreed to by the instructor.

16. Students must keep their given university e-mail address (i.e. firstname.lastname@islander.tamucc.edu ). This will be the means of the instructor communicating with students.

17. All work submitted to the instructor (via e-mail or other means) must be clearly marked with the student’s name and the name and number of the course – this is especially important when work is submitted as an attachment to an e-mail.

18. The instructor reserves the right to make changes to the above with due notice to the students. These changes will be announced to the class (see 16 above) and each student is responsible for keeping herself/himself informed of such changes.
GENERAL DISCLAIMER

I reserve the right to modify the information, schedule, assignments, deadlines, and course policies in this syllabus if and when necessary. I will announce such changes in a timely manner during regularly scheduled lecture periods.